Department of Human Nutrition, Food, and Animal Sciences

Earth Sciences and Hydroponics

HCPS III Benchmarks

8.1.1 Determine the links between evidence and the conclusion of an investigation
8.1.2 Communicate the significant components of the experimental design and results of a scientific investigation
8.8.1 Compare the characteristics of the three main types of rocks
8.8.2 Illustrate the rock cycle and explain how igneous, metamorphic, and sedimentary rocks are formed

NSES

Properties and changes of properties in matter
Geochemical cycles
Structure of the Earth system
Abilities of technological design

Time: Initial setup and explanation of different growing media can be done in one 45 min. class period with previously sprouted material. The subsequent experiment will continue for a 1-2 month period during which measurements and further observations can be made.

Overview

The following activity is serves as a means to teach Earth Sciences. Due to the ability to use various types of media in either a hydroponics or aquaponics setup this allows for the opportunity to teach about what the different media are composed of and conduct an experimental design. The directions in the activity section and materials listed are for a passive hydroponics setup. To use this curriculum in an aquaponics setup simply put each plant in its own self contained type of growing media.

Background Info

What is Hydroponics? The word hydroponics comes from Greek words *Hydro* meaning water and *Ponos* meaning labor. Hydroponics is the science of growing plants in a soil-less media. Similarly, aquaponics grows plants in a soilless media; however aquaponics differs in that it is a system that combines aquaculture, the growing of fish, and hydroponics. When done correctly, aquaponics is a symbiotic, or mutually beneficial, relationship since the fish effluent feeds the plants, and the plants clean the water for the fish. This system is able to function because of microscopic bacteria that convert the nitrogen containing waste, mostly ammonia, into available nitrogen in the form of nitrate that plants can use. Farmers that use aquaponics may profit from the plants ability to grow faster in a soilless medium. This is true for many leafy greens, herbs, and vegetable crops.

Hydroponic gardening is not new, Marco Polo wrote of floating gardens he travelled to China in the 13th

century, and it is believed that the Hanging Gardens of Babylon, one of the 7 ancient wonders of the world, were the first examples of soilless gardening. Even though we say that aquaponics is "soil-less", there is still a media, or substance that the plant roots grow in. This media could be numerous relatively inert substances, including Rockwool, expanded clay (Hydroton), lava cinder, coconut coir, peat moss, diatomite (diatomaceous earth), perlite, pumice, vermiculite, sand, gravel, brick shards, wood fibers, etc., while nutrients are delivered in solution

This brings the question what is soil? Soil can be defined as a natural body consisting of layers of mineral components on the outer surface of the Earth's crust. These mineral components however differ from parent materials such as rock, coral, and organic materials in particle size, physical, and chemical properties. In addition soil typically has pores or small holes that allow room for air and water which are necessary for microorganism like beneficial bacteria and plant roots to thrive. These various types of media are not considered soil since they are not formed naturally and/or composed of different layers. Moreover many of the organisms that may be present in soil may not be present in the soilless media. However, a functioning aquaponics setup will contain some microorganisms such as the Nitrosomonas and Nitrobacter bacteria to convert ammonia to nitrate.

Materials

1 gallon plastic container (clean) for each type of media to be used (the lid diameter should equal that of the netted pot for a tight fit)

1 netted pot for each plant and type of media

1 sprouted short term (1-2mt) plant for each container, leafy greens suggested

Samples of the various media to be covered in class

Chem Gro or equivalent (10-5-14) hydroponic nutrient solution **OR** This may be done with an aquaponics setup using fish effluent

Colored paper or tape to shade plastic to prevent algae growth

Activity

First you will want to have on hand sprouted plants with roots just beginning to emerge from the seed starting media.

Begin class with an explanation of the composition of the different media. See below for suggested media and descriptions.

You may begin the hands on portion by transplanting to respective experimental media in the netted pots.

Add appr. 1 tsp (5g) of the hydroponics nutrients to one gallon of water in the cleaned plastic container.

You may now begin the experiment

Each week track rate of growth of each plant on a graph. Note differences in appearance and health. Also note any changes in the composition of the media as the experiment progresses. Continue experiment through harvest time, about 1-2 months.

Passive hydroponics setup

Netted pot and coconut coir

Hydroponic nutrient

Types of Growing Media for Experiment

Rockwool (stone wool)- formed by melting rock at 1600° C and subjecting to a stream of air or spinning (much like cotton candy) to form long thin fibers. Warning it is harmful to breathe the dust of this product.

Expanded clay pellets (Hydroton)- round pellets of clay that are heated in a kiln at 1200 C which get baked hard and expand with air

Coir- made from the husk fibers of coconut

Perlite- superheated volcanic rock that becomes lightweight and expanded

Pumice- formed from ejected frothy lava or when lava and water are mixed, a type of superheated volcanic rock

Vermiculite- formed when biotite, a type of mica, is superheated and expanded

Coral- a living marine organism existing in colonies that secretes calcium carbonate to for a skeleton under water, a source of "lime" that can form limestone a type of sedimentary rock as well as cement

Diatomaceous Earth- composed of fossilized diatoms, a class of phytoplankton, most of which are unicellular autotrophic algae. A food safe, OMRI approved pesticide via physical/mechanical means.

Wood fiber- fibers from woody plants, restrict to food safe wood fibers

Sand- a rock and mineral particle ranging from 1/16mm to 2mm in size. The components of sand can vary widely but usually either composed of silica (quartz) in inland areas, or weathered limestone containing coral and shell fragments in tropical and coastal areas. In Hawaii the black sand is composed of weathered basalt. The famous greensands on the Big Island are composed of olivine, a mineral. Sand is a component of both brick and concrete. Note: sand utilized as growing media should be sterile. You may wish to use a liner (try coconut cloth or a'a'a) that is porous with the net pot method.

Suggested Vocabulary

Rock (stone)- a naturally occurring aggregate of minerals and/or mineraloids with no specific chemical composition. The three types of rock are sedimentary, igneous, and metamorphic.

Igneous- formed from cooling magma. There are two types, intrusive and extrusive.

Extrusive (Volcanic) rock- formed from magma reaching the surface as lava. Ex basalt, if contains olivine then is called olivine basalt

Intrusive rock- formed from magma cooling slowly and crystallizing within the Earth's
surface. Ex. granite

Sedimentary- formed through the deposition of mineral and/or organic material ex: limestone, found in Moilili karst (Oahu)
http://www.explorebiodiversity.com/Hawaii/hikes/Moiliili/cavemoiliili.html

Metamorphic- can form from subjecting any rock type to higher temperatures and pressures than which the original rock was formed

Mineral- an element or chemical compound that is normally crystalline and that has been formed as a result of geological processes

Crystal- a solid three dimensional substance composed of atoms or molecules, arranged in an orderly manner ex: show carbon vs. graphite vs. diamond

Mineraloids- a mineral like substance that does not form crystals
Media (growth) - any substance that a plant can grow in

Clay- the definition and composition of clay varies widely. An approximate definition of clay would be consisting of a particle size of less than 2 micrometers.

Sand- particle size has a diameter ranging from 1/16mm to 2mm

Reference

http://www.ctahr.hawaii.edu/oc/freepubs/pdf/hg-42.pdf

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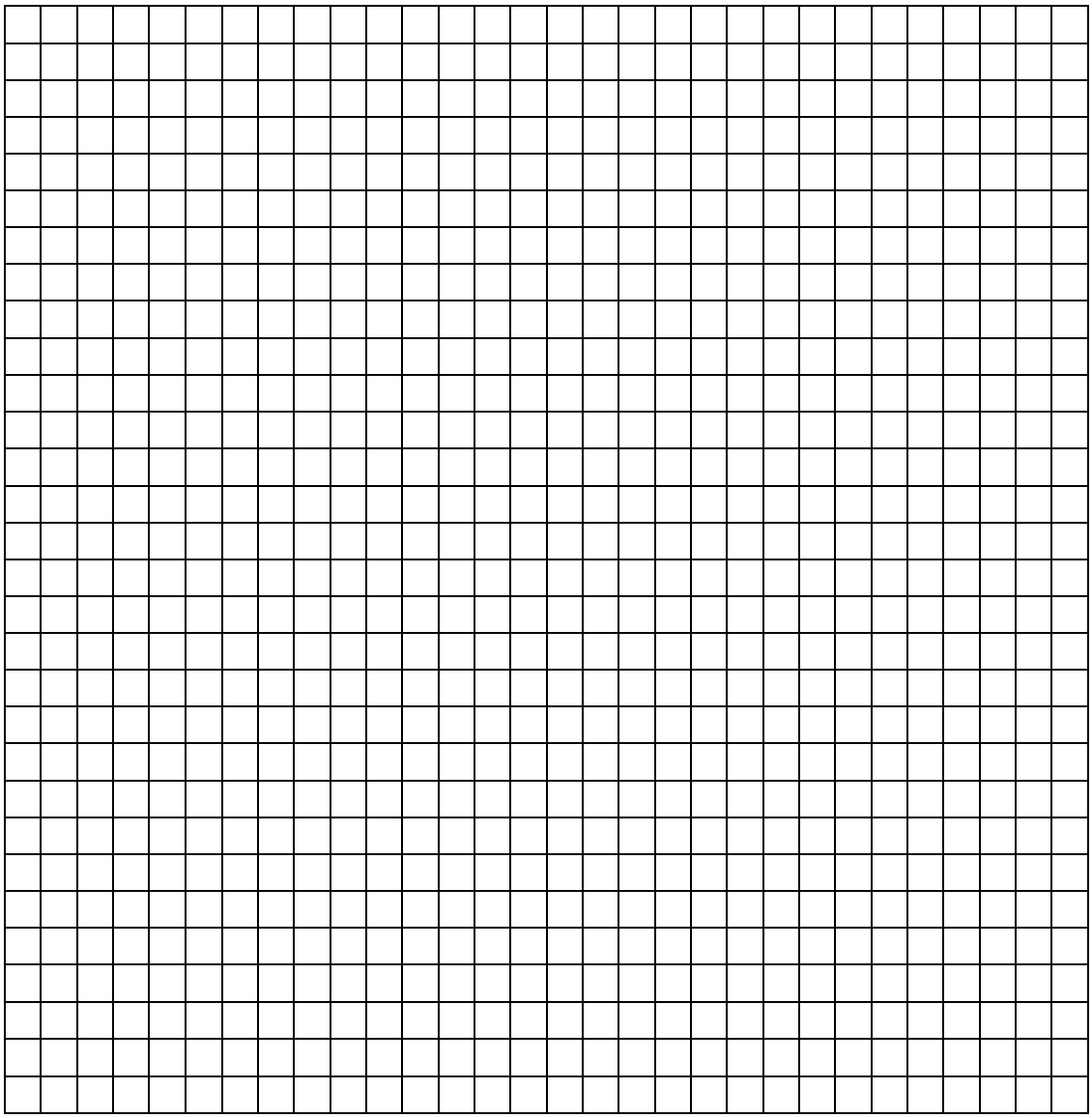
Name _____
Date _____

Observation Log

Graph the growth (height and/or width) of plants from each type of growing media below using Time vs. Growth. Color code for each media type.



What if any differences did you see in some of the different growing media?

Which media gave the best results?

Which product would you use? List three reasons why. Note: factors such as the source of each material, cost, safety, environmental impact, ease of use, and results before your decision is made.